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(71)Applicant : MITSUBISHI SHINDOH CO LTD
(72)Inventor : SUZUKI TAKESHI
FUTATSUKA RENSEI
KUMAGAI SEIJI
KUWABARA MANPEI
CHIBA SHUNICHI
SAKAKIBARA TADAO
ODAJIMA MICHIYO
KUMAGAI JUNICHI

(54) CU ALLOY STEEL HAVING FINE STRUCTURE FOR ELECTRIC AND ELECTRONIC PARTS

(57)Abstract:
PURPOSE: To provide a high strength Cu alloy sheet for electric and electronic parts having a smooth etching face and good in bendability.
CONSTITUTION: The high strength Cu alloy sheet for electric and electronic parts has a compsn. contg., by weight, 0.4 to 5% Ni, 0.05 to 1.2% Si, 0.07 to 2.5% Sn, 0.001 to 0.2% Mg, 0.1 to 3% Zn, 0.007 to 0.25% Fe and 0.0002 to 0.03% Mo, and the balance Cu with inevitable impurities and has a fine structure in which the average grain diameter is regulated to be 30μm or smaller and the maximum diameter of precipitates is regulated to be 3μm or smaller.

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* NOTICES *

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2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] By weight %, nickel:0.4-5%, Si: 0.05-1.2%, Sn:0.07-2.5%, Mg: 0.001-0.2%, Zn:0.1-3%, Contain Fe:0.007-0.25% and Mo:0.0002-0.03%, and the composition which the remainder becomes from Cu and an unescapable impurity, and the diameter of average crystal grain make it 30 micrometers or less. Cu alloy plate for electric electronic parts characterized by having the detailed organization whose overall diameter of a sludge is 3 micrometers or less.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention has a detailed organization, and as a result, the field granularity of an etching side is remarkably small, and is related with Cu alloy plate for electric electronic parts which comes to show the outstanding bending nature.
[0002]
[Description of the Prior Art] It is (% shows weight % hereafter) at weight % which is conventionally indicated by manufacture of various electric electronic parts, such as lead material of a semiconductor device, and a terminal, a connector, at JP,63-86838,A. nickel: 0.8-4% Si:0.1-1.2%, Sn:1-4% Less than [Mg:0.2%] is contained and Cu alloy plate of the start of Cu alloy plate which has the composition which the remainder becomes from Cu and an unescapable impurity, and other many is used.
[0003]
[Problem(s) to be Solved by the Invention] High integration is still more remarkable and it follows on this. on the other hand -- the miniaturization of various electric electronic parts in recent years, and lightweight-izing (thinning) -- to Cu alloy plate The small etching side of field granularity especially smooth besides intensity namely And although the outstanding bending nature which does not have generating of a crack in bending under severe conditions, either is required, for example, it faces forming a highly-integrated circuit pattern in the leadframe material of a semiconductor device by etching and it is indispensable that the front face after etching is smooth In the above-mentioned conventional Cu alloy plate, it is in solution treatment and the state which carried out deposit processing. Usually, since many things to which the path exceeds 5 micrometers exist, the sludge which the diameter of average crystal grain makes it 50-100 micrometers, and a subject becomes from nickel silicification objects, such as nickel2 Si The field granularity of an etching side not only comes to be ruined owing to this, but there is a problem of becoming easy to generate a crack on the occasion of bending.
[0004]
[Means for Solving the Problem] As a result of inquiring that this invention person etc. should develop Cu alloy plate of a detailed organization, then, nickel:0.4-5%, Si: 0.05-1.2%, Sn:0.07-2.5%, Mg: 0.001-0.2%, Zn:0.1-3%, Cu alloy plate which has the composition which Fe:0.007-0.25% and Mo:0.0002-0.03% are contained, and the remainder becomes from Cu and an unescapable impurity Where solution treatment and deposit processing (aging treatment) which follows this are performed A mean particle diameter makes it 30 micrometers or less, and the overall diameter of a sludge comes to have the detailed organization which is 3 micrometers or less. in this way Cu alloy plate of a detailed organization Surface roughness: The smooth etching side 1 micrometer or less was shown, and also the outstanding bending nature and outstanding high intensity were provided, and the research result of also coming to have the further excellent solder heatproof detachability was obtained.
[0005] This invention is made based on the above-mentioned research result. nickel:0.4-5%, Si: 0.05-1.2%, Sn:0.07-2.5%, Mg: 0.001-0.2%, Zn:0.1-3%, Contain Fe:0.007-0.25% and Mo:0.0002-0.03%, and the composition which the remainder becomes from Cu and an unescapable impurity, and

the diameter of average crystal grain make it 30 micrometers or less. It has the feature in Cu alloy plate for electric electronic parts which has the detailed organization whose overall diameter of a sludge is 3 micrometers or less and which especially whose etching side was smooth, and was excellent in bending nature, and was excellent also in solder heatproof detachability.

[0006] Below, in Cu alloy plate of this invention, the reason which limited the component composition as above-mentioned is explained.

(a) nickel and Si, although the component of these has the operation which raises intensity, without forming and having in a base the sludge which carries out a distributed deposit minutely and which a subject becomes from nickel2 Si after deposit processing, and reducing conductivity sharply If the content cannot secure desired intensity less than [nickel:0.4%] and less than [Si:0.05%], respectively but the content, on the other hand, exceeds nickel:5% and Si:1.2% Since conductivity and solder heatproof detachability came to have fallen, the content was determined as nickel:0.4-5% and Si:0.05-1.2%, respectively.

[0007] (b) although the SnSn component had the operation which it dissolves [operation] on a base and raises intensity much more, the effect of a request [at less than 0.07%] of the content to the aforementioned operation was not acquired, but since conductivity came to have fallen when the content exceeded 2.5% on the other hand, the content was determined as 0.07 - 2.5%

[0008] (c) although a MgMg component has the operation which raises hot-working nature, if the hot-working disposition top effect of a request of the content at less than 0.001% is not acquired but the content exceeds 0.2% on the other hand, Mg oxide etc. will involve in an ingot -- having -- being easy -- since hot-rolling nature and surface cleaning nature came to be spoiled owing to this, the content was determined as 0.001 - 0.2%

[0009] (d) Although the ZnZn component had the operation which it dissolves [operation] on a base and raises solder heatproof detachability, the content could not secure desired solder heatproof detachability at less than 0.1%, but even if the content exceeded 3% on the other hand, since much more improvement effect did not show up, it determined the content as 0.1 - 3%.

[0010] (e) Fe and Mo, although severe bending also has the operation which suppresses generating of a crack while suppressing big and rough-ization of the crystal grain for the heating at high temperature of solution treatment for the component of these, and also preventing and having big and rough-ization of a sludge in it and smoothing the surface roughness after etching to 1 micrometer or less Less than [Fe:0.007%] and less than [Mo:0.0002%], a desired effect is not acquired for the content by the aforementioned operation, respectively. Since hot rolling nature and bending nature came to have fallen on the other hand when the content exceeded Fe:0.25% and Mo:0.03%, the content was determined as Fe:0.007-0.25% and Mo:0.0002-0.03%.

[0011]

[Example] Below, an example explains Cu alloy plate of this invention concretely. Cu alloy molten metal with the component composition shown in Tables 1-3 with the usual low frequency ditch-type fusion furnace, respectively is prepared. It considers as an ingot with the size of 1600mm. a semi-continuous casting method -- thickness: -- 160mmx width-of-face: -- 450mmx length: -- To this ingot, hot-roll at the predetermined rolling start temperature within the limits of 750-980 degrees C, consider as a thickness:11mm hot-rolling board, and to this hot-rolling board, after water cooling, where facing of every 0.5mm both-sides edge is carried out every 3mm, respectively, vertical both sides The rate of rolling : where it performed 87% of cold rolling, and it considered as the thickness:1.32mm cold-rolled board and middle **** of maintenance is further given to the predetermined temperature within the limits of 400-650 degrees C for 1 hour at this The rate of rolling : Perform 75% of cold rolling and it considers as a thickness:0.33mm cold-rolled board. Subsequently, after holding for 5 to 300 seconds at this to the predetermined temperature within the limits of 750-950 degrees C, It is 40 degrees C/sec about a 750-500-degree C temperature requirement. Solution treatment cooled with the above cooling rate is performed. Deposit processing of maintenance is succeedingly performed

to the predetermined temperature within the limits of 400-500 degrees C for 3 hours, and rate:of rolling25% of cold rolling is performed further, and finally, maintenance is distorted to the predetermined temperature within the limits of 250-350 degrees C, and it anneals to it for 1 hour. Cu alloy plates 1-4 were manufactured, respectively this invention Cu alloy plates 1-14 of the diameter of average crystal grain and sludge overall diameter which are similarly shown in Tables 1-3, respectively, the comparison Cu alloy plates 1-9, and conventionally.

[0012] In addition, the component content (* mark is attached) of either of the constituents of Cu alloy separates from the comparison Cu alloy plates 1-9 from this invention range. Moreover, the diameter of average crystal grain was measured using the optical microscope, and the sludge which measured ten arbitration by one 5000 times the scale factor of this, and showed the overall diameter among this measurement part about the sludge using the scanning electron microscope further was shown.

[0013] Next, about various kinds of Cu alloy plates obtained as a result, tensile strength and elongation were measured with the tension test based on JIS-Z2241, similarly conductivity was measured based on JIS-H0505, the bending examination and the heat friction test of solder were performed further, and the surface roughness of an etching side was also measured.

[0014] minimum bend-radius:r (mm) in which, as for a bending examination, a crack generates a bending shaft on the surface of a test piece for a rolling parallel direction (the direction of bad way) according to the V block method of JIS-Z2248 -- measuring -- the ratio of this r and thickness:t of a test piece -- it carried out by evaluating by :r/t

[0015] The heat friction test of solder processes a test piece with the thickness:0.25mmx width-of-face:15mmx length:60mm size by rosin flux, and is immersed during the solder bath of a temperature:230 degree C 60%Sn-40%Pb alloy. The aforementioned solder was made to adhere to the front face, it heated on condition that maintenance at temperature:150 degree C among the atmosphere for 1000 hours, and carried out after heating on the conditions which carry out 180-degree adhesion bending of the test piece, and return it 180 degrees again, the existence of the solder ablation in this 180-degree bending section was observed, and this state estimated the heat-resistant detachability of solder.

[0016] Moreover, temperature after the surface roughness of an etching side degreases the front face of a test piece: It is immersed in ferric-chloride solution 42 45-degree C%. the thickness direction -- 0.1**0.02mm -- **********ing -- the etching side of this result -- a rolling direction -- receiving -- the right-angled direction -- length: -- the surface roughness of every ten 0.8mm arbitration was measured, and it was shown with the highest (coarse) surface roughness among this ten measurement result These measurement results were shown in Tables 4 and 5.

[0017]

[Table 1]

種別		成分組成（重量%）								平均結晶粒径（μm）	析出物の最大径（μm）
		Ni	Si	Sn	Mg	Zn	Fe	Mo	Cu+不純物		
本発明Cu合金板材	1	0. 48	0. 07	2. 41	0. 121	0. 90	0. 211	0. 0128	残	8	0. 6
	2	1. 95	0. 51	0. 47	0. 005	0. 87	0. 012	0. 0004	残	15	1. 3
	3	4. 67	1. 12	0. 51	0. 008	0. 95	0. 062	0. 0008	残	8	1. 6
	4	1. 88	0. 47	0. 09	0. 011	1. 02	0. 051	0. 0011	残	12	0. 8
	5	1. 96	0. 44	0. 56	0. 008	1. 06	0. 055	0. 0009	残	10	0. 9
	6	1. 83	0. 45	2. 23	0. 009	0. 92	0. 048	0. 0008	残	11	0. 8
	7	1. 95	0. 52	0. 51	0. 010	0. 12	0. 070	0. 0008	残	10	0. 9
	8	2. 02	0. 45	0. 44	0. 008	2. 94	0. 066	0. 0006	残	12	1. 1
	9	2. 12	0. 50	0. 49	0. 002	0. 93	0. 032	0. 0013	残	8	0. 6
	10	1. 95	0. 48	0. 52	0. 189	0. 95	0. 045	0. 0008	残	10	1. 0

[0018]
[Table 2]

種別		成分組成（重量%）								平均結晶粒径（μm）	析出物の最大径（μm）
		Ni	Si	Sn	Mg	Zn	Fe	Mo	Cu+不純物		
本発明Cu合金板材	11	1. 93	0. 40	0. 47	0. 003	1. 02	0. 008	0. 0009	残	25	1. 1
	12	1. 89	0. 53	0. 46	0. 013	0. 88	0. 238	0. 0011	残	10	0. 7
	13	2. 04	0. 44	0. 49	0. 009	0. 87	0. 014	0. 0003	残	25	1. 5
	14	1. 93	0. 47	0. 51	0. 011	0. 85	0. 058	0. 0252	残	6	0. 5
比較Cu合金板材	1	0. 33*	0. 10	0. 45	0. 008	0. 85	0. [illegible]21	0. 0006	残	18	1. 1
	2	5. 19*	1. 11	0. 85	0. 003	0. 72	0[illegible]43	0. 0004	残	14	2. 0
	3	2. 03	0. 04*	0. 43	0. 009	0. 84	[illegible]045	0. 0011	残	18	0. 7
	4	2. 15	1. 34*	0. 64	0. 006	0. 82	0. 065	0. 0009	残	8	0. 9
	5	1. 78	0. 40	0. 05*	0. 005	0. 81	0. 052	0. 0004	残	12	1. 5
	6	1. 95	0. 45	2. 72*	0. 008	0. [illegible]3	0. 055	0. 0008	残	10	0. 9

（＊印：本発明範囲外）

[0019]
[Table 3]

種別		成分組成（重量%）								平均結晶粒径（μm）	析出物の最大径（μm）
		Ni	Si	Sn	Mg	Zn	Fe	Mo	Cu+不純物		
比較Cu合金板材	7	1.94	0.67	0.44	0.004	0.08*	0.043	0.0010	残	11	1.1
	8	2.03	0.47	0.51	0.004	0.83	0.005*	－*	残	50*	6.5*
	9	1.93	0.58	0.38	0.009	0.95	0.283*	0.0342*	残	8	0.6
従来Cu合金板材	1	0.93	0.23	2.06	0.104	－	－	－	残	70	5.5
	2	1.98	0.63	0.78	0.011	－	－	－	残	65	7.5
	3	3.85	1.09	0.63	0.102	－	－	－	残	50	8.0
	4	1.94	0.77	3.92	0.096	－	－	－	残	60	7.0

（＊印：本発明範囲外）

[0020]
[Table 4]

種別		引張強さ (N／mm^2)	伸び (%)	導電率 (%) IACS	曲げ加工性 (r／t)	はんだ剥離の有無	エッチング面の表面粗さ (μm)
本発明Cu合金板材	1	760	6	35	1.6	無	0.7
	2	815	9	43	1.4	無	0.8
	3	920	9	36	1.6	無	0.9
	4	780	7	49	1.2	無	0.8
	5	810	9	42	1.2	無	0.8
	6	860	10	35	0.8	無	0.7
	7	815	9	44	1.0	無	0.7
	8	815	8	39	1.2	無	0.8
	9	820	7	43	1.2	無	0.7
	10	815	8	38	1.0	無	0.8
	11	810	9	43	1.6	無	0.8
	12	815	8	41	1.0	無	0.8
	13	805	9	42	1.6	無	0.9
	14	790	6	43	1.6	無	0.7

[0021]
[Table 5]

種別		引張強さ (N/mm²)	伸び (%)	導電率 (% IACS)	曲げ加工性 (r/t)	はんだ剥離の有無	エッチング面の表面粗さ (μm)
比較Cu合金板材	1	580	8	48	1.6	無	0.9
	2	920	9	30	1.8	有	1.2
	3	520	7	38	1.0	無	0.9
	4	810	9	31	1.8	有	0.7
	5	680	8	53	1.8	無	0.9
	6	850	9	24	1.0	無	0.8
	7	820	8	37	1.8	有	0.8
	8	810	8	38	5.0	無	3.0
	9	810	4	39	3.6	無	0.7
従来Cu合金板材	1	780	7	36	3.8	有	2.9
	2	810	8	33	6.0	有	3.2
	3	870	9	35	6.5	有	3.5
	4	900	9	20	4.5	有	3.0

[0022]
[Effect of the Invention] this invention Cu alloy plates 1-14 all have high intensity and conductivity equivalent to Cu alloy plates 1-4 conventionally, and, on the other hand, have become the surface roughness of an etching side and bending nature, and the thing that was further excellent much more about the heat-resistant detachability of solder as compared with Cu alloy plates 1-4 conventionally from the result shown in Tables 1-5. Moreover, if the component content of either of the constituents of Cu alloy separates from the range of this invention so that the comparison Cu alloy plates 1-9 may see, a bird clapper is clear to the thing of the above-mentioned properties in which one of properties was inferior at least.
[0023] As mentioned above, since an etching side is smooth, and has the outstanding bending nature and is further excellent also in the heat-resistant detachability of solder, especially Cu alloy plate of this invention demonstrates the performance which was [the case where it uses for manufacture of various electric electronic parts, such as leadframe material of the high semiconductor device of a degree of integration with which these properties are demanded, and a terminal which a configuration complicates and has it in the inclination of thinning, a connector,] excellent in the long period of time.

[Translation done.]